ACCESSION #: 9405160182
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Salem Generating Station - Unit 1 PAGE: 1 OF 9

DOCKET NUMBER: 05000272

TITLE: Reactor Trip From 25% Power/Two Safety Injections,
Manually Initiated Main Steam Isolation, And
Discretionary Declaration Of ALERT
EVENT DATE: 04/07/94 LER #: 94-007-01 REPORT DATE: 05/10/94

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 073

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(i), 50.73(a)(2)(iv) and OTHER: Special Rep.

LICENSEE CONTACT FOR THIS LER:
NAME: M. J. Pastva, Jr. - LER Coordinator TELEPHONE: (609) 339-5165

COMPONENT FAILURE DESCRIPTION:
CAUSE: SYSTEM: COMPONENT: MANUFACTURER:
REPORTABLE NPRDS:

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

At 1050 hours on 4/7/94, an automatic Reactor trip occurred, was immediately followed by an Emergency Core Cooling System (ECCS) Safety Injection (SI) and, at 1100 hours an Unusual Event was declared. At 1105 hours, the SI signal was reset and ECCS flow reduction began. Reactor Coolant System temperature increased, Pressurizer level increased to >100%, steam generator pressure increased and main steam safety valves lifted, and at 1128 hours, a second automatic SI occurred. At 1316 hours, a precautionary ALERT was declared. HOT SHUTDOWN was achieved at 0106 hours on 4/8/94, and at 1124 hours (same day), COLD SHUTDOWN was achieved. The trip resulted from assigning inappropriate priority of actions and improperly monitoring reactor power while withdrawing rods. The first SI resulted from inadequate control of primary loop temperature, concurrent with a false high steam flow signal. The second SI resulted from low Pressurizer pressure due to lifting a steam generator safety valve. Involved personnel will complete remedial

training and evaluation. Operating procedures have been revised, as appropriate. Component testing, repairs, and modifications have been made, as required.

END OF ABSTRACT

PLANT AND SYSTEM IDENTIFICATION:

Westinghouse - Pressurized Water Reactor

Energy Industry Identification System (EIIS) codes are identified in the text as {xx}

IDENTIFICATION OF OCCURRENCE:

Reactor Trip From 25% Power/Two Safety Injections, Manually Initiated Main Steam Isolation, And Discretionary Declaration of ALERT

Event Date: 4/7/94

Original Report Date: 5/6/94
Supplement Report Date: 5/10/94

This report was initiated by Incident Report No. 94-102.

CONDITIONS PRIOR TO OCCURRENCE:

Mode 1 Reactor Power 73% - Unit Load 800 MWe
T sub ave at 562 degrees Fahrenheit (F). Control Rods in manual control with Bank D rods at 195 steps.

The Unit was at reduced power due to seasonal problems with excessive Delaware River marsh grass/debris affecting the Circulating Water (CW) {UA} intake structure. The amount of grass/debris loading in the river in was excess of four times the seasonal average recorded over a 17 year period.

Operational challenges were being encountered maintaining the CW circulators {UA} and traveling screens in service. Between 1016 and 1043 hours on April 7, 1994, a load reduction was in progress to take the Main Turbine {TA} off-line following "emergency" tripping of 13A and 13B CW traveling screens and subsequent trips of 11A, 11B, and 12A circulators. Reactor power had been reduced to 7% with

Unit load at 80 MWe. 11A and 12B circulators were in service prior to the trip. In response to decreasing T sub ave, at approximately 1049 hours (same day) control rods were being manually withdrawn to increase Reactor Coolant System (RCS) {AB} temperature.

DESCRIPTION OF OCCURRENCE:

During rod withdrawal to restore Reactor Coolant System (RCS) temperature, Reactor power increased to 25% and, at 1050 hours, on April 7, 1994, an automatic Reactor Protection System (RPS) {JC} trip occurred. This was immediately followed by an Emergency Core Cooling System {BQ} Safety Injection (SI), (Train A) and, at 1100 hours, an Unusual Event (UE) was declared. Following the reactor trip/safety

DESCRIPTION OF OCCURRENCE: (cont'd)

injection, the Main Steam isolation valves were closed due to the primary plant temperature decrease below 547 degrees F. The RCS temperature started to increase at this time.

At 1105 hours, the SI signal was reset on Train A. The ECCS pumps were secured and normal charging was placed in service. Pressurizer level increased to greater than 100% indication (solid condition) and pressure increased due to the SI charging flow and increasing RCS temperature. At 2335 pounds per square inch gauge (psig), the Pressurizer power operated relief valves (PORVs) {AB} cycled automatically. Steam Generator (SG) pressure also increased and two safety valves on 11 SG loop lifted causing RCS temperature and pressure to drop rapidly. At 1128 hours, a second SI automatically occurred on Train B. After the second SI was reset at 1143 hours, the Pressurizer Relief Tank (PRT) {SB} rupture disc operated due to discharge from the PORVs. At 1316 hours, an ALERT was declared, in accordance with Event Classification Guide 17B, as a precautionary step to mobilize engineering resources for assistance, if needed. Required notifications were made in accordance with 10CFR50.72 and the Salem Emergency Plan.

NRC discretionary enforcement was obtained, to provide an additional 12 hours beyond the six hours to HOT SHUTDOWN, required by Technical Specification (TS) 3.0.3, due to the blocking of the automatic SI signals. The Pressurizer bubble was reestablished at approximately 1500 hours. At 0106 hours on April 8, 1994, cooldown to HOT SHUTDOWN was achieved and at 1124 hours (same day), COLD SHUTDOWN was achieved.

ANALYSIS OF OCCURRENCE:

On the morning of April 7, 1994, Salem Unit 1 encountered problems maintaining Main Condenser vacuum due to the ongoing seasonal river grass/debris influx affecting CW circulator availability. A Unit load reduction was in progress to take the Main Turbine off-line. Reactor power was reduced to 7% with Unit load at 80 MWe. Reduction of power to less than 10% automatically reinstated low power trip setpoints. Due to the power reduction T sub ave was 553 degrees F. Two manual borations were performed and control rods were manually inserted to return T sub ave to program. During this time, the Senior Reactor Operator (SRO) directed the primary Nuclear Control Operator (NCO) to transfer the power supply to the Group Buses from the station Auxiliary Power Transformer to the 11 and 12 Station Power Transformers. During this evolution, T sub ave decreased to 530 degrees F.

Control rods were then withdrawn to increase T sub ave and Reactor power

ANALYSIS OF OCCURRENCE: (cont'd)

increased to 25%. Power Range channels 1N42 and 1N44 initiated an automatic Reactor trip and trip of the Main Turbine. An SI occurred immediately thereafter, when the steam line high steam flow bistables actuated on a short duration pressure pulse, concurrent with T sub ave below 543 degrees F. SI Train A logic partially actuated and SI Train B logic did not actuate due to the short duration of the high steam flow signal.

The high steam flow signal was due to a pressure pulse in the main steam lines caused by closure of the turbine stop valves. Emergency Operating Procedures (EOPs) were entered and components were positioned in response to the SI signal. The SI Train A was reset with the automatic actuation in the "blocked" condition. The Train B automatic logic remained armed. After the Main Steam isolation valves were closed, T sub ave increased due to decay heat and Reactor Coolant Pump {AB} operation. Pressurizer pressure increased, due to increasing T sub ave and SI charging flow and the Pressurizer power operated relief valves, 1PR1 and 1PR2, automatically cycled at 2335 psig. SG pressures also increased in response to increasing T sub ave. The secondary NCO did not open the Main Steam atmospheric relief valves (MS10s) {SB} in response to the increasing SG pressures. Two safety valves {SB} on 11 SG loop lifted causing T sub ave and primary pressure to drop rapidly. Operators were in the process of initiating a manual SI to respond to the plant condition, however, a second SI, from the Train B logic automatically occurred. The Pressurizer Relief Tank (PRT) rupture disc operated due to the PORVs relieving to the PRT. The SI was terminated, the Pressurizer bubble was reestablished and COLD SHUTDOWN was achieved.

Personnel Performance

For approximately six weeks prior to the event, the Salem operating shift crews were challenged by the marsh grass/debris affecting the CW intake structure. This has resulted in extended periods of load reductions and numerous transients regarding maintaining operation of the CW circulators.

The Reactor trip is attributed to personnel error, including inadequate command and control. This occurred when the operating crew took inappropriate action, which resulted in an automatic RPS actuation on the Nuclear Instrumentation System {IG} power range low setpoint. The control rod withdrawal to correct T sub ave was not correctly implemented and resulted in reactor power increasing at a faster rate than anticipated by the NCO. The Nuclear Shift Supervisor (NSS) did not maintain adequate oversight of changing plant conditions and inappropriately prioritized the actions of the operating crew.

ANALYSIS OF OCCURRENCE: (cont'd)

Personnel Performance (cont'd)

He directed the primary NCO to transfer the power supply to the Group Buses from the station Auxiliary Power Transformer to the 11 and 12 Station Power Transformers. As a result, the NCO's focus was divided between a number of monitoring activities. The NSS recognized the low T sub ave condition and withdrew control rods a few steps, but realizing this was counter to management expectations and training he discontinued this action. After the electrical bus transfer was completed, the NSS directed the NCO to restore T sub ave.

Following the reduction of Reactor power to 7% and transfer of the Group Buses, the primary Nuclear Control Operator (NCO) recognized that T sub ave was below the program value. Because of his focused attention on restoring T sub ave, the NCO did not properly monitor reactor power while withdrawing rods.

The MS10s were set in automatic control, but did not respond to the increasing pressure. The operating crew did not adequately communicate RCS temperature and no trending of the T sub ave value was performed by the NCOs. The required action of the secondary NCO, to take manual control of the valves and open them to prevent lifting of the SG safety relief valves, was not done in a timely manner.

Equipment Performance

At the time of the event, rod control for the Unit was in manual for troubleshooting of suspected problems with automatic rod control. Subsequent troubleshooting, which included testing of the Rod Speed circuitry, showed the Rod Control System was fully functional.

Due to "shadowing" by rod position and T sub ave being off program low, the Nuclear Instrument System (NIS) Intermediate Range (IR) Rod Stop at 20% did not actuate to prevent the increase in power to above 25%. It was concluded that the system, functioned, as designed. (The NIS is not an Engineered Safety Feature and credit for it is not taken in the plant accident analysis.)

The first SI occurred due to T sub ave below program coincident with an erroneous high steam line flow signal. Due to the short duration of the high steam line pressure pulse, the SI signal was only generated by the Train A Solid State Protection System (SSPS) {JC}. Train B SSPS did not respond to the SI signal due to acceptable differences in the actuation time of the SSPS.

ANALYSIS OF OCCURRENCE: (cont'd)

Equipment Performance (cont'd)

The high steam line flow signal occurred when the turbine stop valves closed following the Reactor trip signal. This generated a pressure pulse of sufficient magnitude and duration to actuate the steam line high steam flow bistables. Post event testing verified both channels of high steam flow were functioning within overall time response required by TS and showed no indication of degradation.

Following the first SI, main steam isolation valves (MSIVs) {SB} 13 and 14 MS167 closed, while MSIVs 11 and 12MS167 did not automatically close. The 11 and 12MS167 did not close due to differences in the response of the actuation circuitry to the short duration pulse of the SI signal.

The closure of the Main Turbine stop valves caused a pressure pulse of sufficient magnitude and duration to initiate a high steam flow signal. Due to the short duration of this signal, the SI cleared before some plant equipment could latch and operate to allow completion of all component actions. Although Train "B" did not respond due to the short duration of the pulse, it operated within design specifications and no equipment failures were noted.

Several main steam safety valves operated, per design, during the event, due to the increase in secondary loop pressure.

Operation of the PRT rupture disc occurred per design.

During the cycling of PORVs 1PR1 and 1PR2, the valves performed as designed.

Response of the MS10s to open in automatic is a previously identified condition. The valves have a delay in opening due to the valve controller being below its setpoint for an extended period of time. The design of the valve controller allows the controller output to saturate low when the process is below the control setpoint. This necessitates manual action by the control operator. Following this event, individual problems involving a binding servo drive in the 11MS10 controls, a logic transfer circuit board in the 13MS10 controls, and a missing gear tooth and a misaligned drive shaft in the 14MS10 controls were also identified.

ANALYSIS OF OCCURRENCE: (cont'd)

Equipment Performance (cont'd)

The following SI components did not respond to the first SI signal:

Train A

11 and 12MS167, main steam isolation valves for 11 and 12 SGs, did not close.

11, 12, 13, and 14BF13, SG feedwater motor-operated inlet isolation valves did not close.

11 and 12 SG feed pumps did not trip.

Train B

SSPS Train B did not respond to the high steam flow SI.

Subsequent testing and analysis indicates the pressure pulse from closure of the main turbine stop valves was not of sufficient duration to initiate the complete train logic. Therefore, it is concluded the above-listed equipment responded, as designed.

The second SI of this event constituted the 21st accumulated SI actuation cycle to date.

APPARENT CAUSE OF OCCURRENCE:

This event is attributed to "Personnel Error", as classified in Appendix B of NUREG-1022. The Reactor trip and initial SI occurred when the NSS failed to maintain adequate command and control, communications, and assigned inappropriate priority of actions in response to the changing plant conditions. The NCO added positive reactivity change at a rate which caused power to increase too quickly, resulting in the reactor trip. The response of the operating crew to the changing conditions of the event was affected by some equipment problems and procedural guidance.

PREVIOUS OCCURRENCES:

Prior events involving excessive CW intake grass/debris have been reported in LERs 272/83-033/01T, 272/93-011-00, and 311/89-013-00.

A prior event involving greater than 100% level (solid condition) in

PREVIOUS OCCURRENCES: (cont'd)

the Pressurizer was reported in LER 311/89-005-00.

SAFETY SIGNIFICANCE:

This event did not affect the health and safety of the public. This event is reportable pursuant to 10CFR50.73(a)(2)(iv), due to the RPS and SI actuations and 10CFR50.73(a)(2)(i)(B), due to entry into TS 3.0.3. In addition, this report fulfills the requirement for a Special Report within 90 days of an SI, as required by TS 3.5.2., ACTION: b.

The combination of all personnel actions and equipment performance contributed to the plant response. An analysis of that response was performed which addressed the safety significance of all contributing factors. The plant response was reviewed against Condition II safety criteria from Chapter 15 of the Salem Updated Final Safety Analysis Report. This review, which included the safety limits on peak primary and secondary system pressure, and minimum Departure from Nucleate Boiling Ratio, showed these limits were not exceeded. In addition, similar consideration was given to plant component fatigue, fuel integrity, and the effects of lower than normal T sub ave. This showed all component fatigue analytical conclusions remain valid, no fuel failures have resulted from the event, and the effects of the lower than normal T sub ave were insignificant with respect to plant safety.

CORRECTIVE ACTION:

The PRT rupture disc has been replaced.

The CW traveling screens were repaired and returned to service.

Operating procedures have been revised, as appropriate.

Simulator training on this event has been conducted with all operating shifts.

The MS10s controls have been tested and repaired, as required.

Modifications have been made to the MS10s to improve performance.

Changes to the plant design have been implemented to dampen/filter the erroneous high main steam flow signal generated by closure of the Main Turbine stop valves.

The involved licensed personnel were removed from Licensed Operator duties. Remedial training and evaluation will be performed for these

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CORRECTIVE ACTION: (cont'd)

personnel, prior to their resuming licensed duties.

The PORVs have been inspected and greater than expected wear was noted on several components. Internal parts will be replaced, as required, prior to return to power.

The Salem Emergency operating Procedures will be reviewed and revised, as required.

General Manager -
Salem Operations
MJPJ: PC

ATTACHMENT TO 9405160182 PAGE 1 OF 1

PSE&G

Public Service Electric and Gas Company P.O. Box 236 Hancocks Bridge, New Jersey 08038

Salem Generating Station

May 10, 1994

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

Dear Sir:

SALEM GENERATING STATION
LICENSE NO. DPR-70
DOCKET NO. 50-272
UNIT NO. 1

SUPPLEMENTAL LICENSEE EVENT REPORT 94-007-01

This supplemental Licensee Event Report is being submitted pursuant to Code of Federal Regulations 10CFR 50.73. It corrects an editorial error within the "ABSTRACT" section of page 01 of the report.

Sincerely yours,

J. J. Hagan
General Manager -
Salem Operations

MJPJ:pc

Distribution

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